
BRIDGE BEARING FORCES

The purpose of a bridge bearing is to support the superstructure at a constant elevation, to carry all forces from the superstructure into the substructure and to allow necessary superstructure motions to take place.

Forces to be applied to bridge bearings can come from any of the loads associated with the bridges. These forces can be combined into the basic loading vectors described below.

DOWNWARD FORCE

This force can be considered to act directly through the center of the bearing. It is normally made up of dead load and live load.

TRANSVERSE FORCE

This force acts normal to the centerline of the bridge in a horizontal direction at the top of the bearing. It is made up of wind, earthquake and/or other horizontal forces, and must be resisted by keys, anchor bolts, pintles, or other suitable means. The transverse force will develop a moment within the bearing itself, which is equal to the product of the force times the height of the bearing. This moment may be significant for tall bearings and should be included in the analysis.

LONGITUDINAL FORCE

This is any horizontal force acting parallel to the centerline of the bridge, including thermal motion forces and forces due to concrete shrinkage. Longitudinal forces generally will not be developed in an expansion bearing. Expansion bearings may, however, develop significant longitudinal forces due to sliding or rolling friction and shear deformation forces in neoprene bearings. Where these forces may exist, they must be accounted for in the design. Curved bridges require special consideration.

UPLIFT FORCES

With the exception of elastomeric pads, bearings shall be designed for uplift forces due to earthquake in an amount equal to ten percent of the vertical dead load reaction of the superstructure.

OTHER FORCES

Rotational bearing forces in each of the three planes may be developed by a particular structure. These forces should be considered and accounted for in the design when they are significant.

COLORADO DEPARTMENT OF TRANSPORTATION STAFF BRIDGE BRANCH BRIDGE DESIGN MANUAL	Subsection: 14.2 Effective: August 1, 2002 Supersedes: May 1, 1992
BEARING DEVICE TYPE I AND TYPE IV	
Policy	Commentary

Type I and Type IV bearings can be fixed or expansion-type. Refer to Staff Bridge Worksheets B-512-1 and B-512-4 for details and to the CDOT Standard Specifications, Section 512, for fabrication requirements.

The design shall be in accordance with Chapters 10 and 14 of AASHTO and the AASHTO Specifications for Seismic Design. Unless approved by the Bridge Engineer, steel reinforced elastomeric bearings shall be designed in accordance with AASHTO Chapter 14, Method 'B'. (C1)

The shear strain shall not exceed 50%.

Total movement shall be determined by using the methodology provided in Section 15 for expansion joints, without a temperature safety factor, except that the skew factor will not be used to reduce the magnitude of movement.

Elastomer hardness greater than 60 Durometer shall not be used in reinforced bearings.

Leveling pads used for locked-in girders shall be included in the cost of the work and shall be designed in accordance with AASHTO Chapter 14 for dead load only without considering longitudinal, transverse and rotational movements. Leveling pads shall be thick enough to prevent girder-to-support contact due to anticipated girder rotations up through and including the deck pour.

C1: AASHTO Method 'B' allows higher compressive stresses and more slender bearings, which can lead to reduced horizontal forces on the substructure. However, these bearings need to be tested due to the relaxed procedures of design. It is especially important to check concrete bearing stresses when using AASHTO Method 'B'.

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The plates embedded in precast
girders are included in Item 618.

Type IV bearings are primarily used
as a competitive alternate to Type
III Bearings. Only one bearing type
shall be used across the width of the
bridge at any given substructure
location.

Sole plates shall be a minimum 3/4"
thickness.

BEARING DEVICE TYPE II AND TYPE V

Type II and Type V Bearings shall be used as expansion bearings. Refer to Staff Bridge Worksheets B-512-2 and B-512-5 for details and to the CDOT Standard Specifications Section 512 for fabrication requirements.

Refer to Section 10, 14, and 15 of AASHTO for compressive stress, strain, and rotation criteria and the AASHTO Specifications for Seismic Design.

The design coefficient of friction between the PTFE and stainless steel shall be 8%.

Refer to *Subsection 14.2* for additional design requirements.

Type V Bearings are primarily used as a competitive alternate to Type III bearings. Only one bearing type shall be used across the width of the bridge at any given substructure location.

BEARING DEVICE TYPE III

1. Refer to CDOT Staff Bridge Worksheet B-512-3 for details.
2. Refer to Predated Special Provision 512 for fabrication and construction requirements.
3. Refer to Section 15 of AASHTO for PTFE requirements.
4. When the loading and rotational requirements are impractical for a Type II Bearing, a Type III Bearing shall be used.
5. The coefficient of friction for the interface of PTFE and stainless steel shall be 5%.
6. The plans shall include a plan view showing the orientation of the bearings along the bent line. One line of guided bearings is desirable near the centerline of the structure.
7. Designate the bearings as follows:
 - a. Multidirectional movement EXP
 - b. Guided GD
 - c. Fixed FX
8. The lateral loading of a bearing shall not exceed 1/6 of the vertical loading. If the total lateral capacities of the FX and GD Bearings are less than the total calculated horizontal load to the bridge unit, additional lateral restraint must be provided (i.e. pintles).
9. The allowable loading on any PTFE surface shall be 3500 psi.
10. Type I and Type II Bearing Devices shall not be mixed with Type III Bearing Devices.
11. These bearings shall be paid for as "each" under Item 512 and shall include anchor bolts, sole plates, masonry plates, and the internal manufactured components.
12. The temperature (Fahrenheit) ranges for determining movements are:
 - a. Steel girders - 140 degrees.
 - b. Concrete girders - 180 degrees (Includes a factor of 2 to account for creep and shrinkage).
 - c. The sole plates and top plates shall be oversized an additional 4 inches, longitudinally.
13. Bearings shall be removable. (This is to be accomplished by raising the structure 1/4 inch.)
14. Substructure drawings shall show locations for lifting the superstructure when removing bearing.
15. The minimum bearing height shall be 7 inches.